CLAIMS

1. An organometallic complex structure comprising:

a metal ion;

an organic compound capable of binding to the metal ion;

a pillar ligand capable of binding to the metal ion; and

an organic polymer capable of interacting with the metal ion;

wherein the organometallic complex structure has a porous structure.

2. The organometallic complex structure according to claim 1, wherein the molar ratio of the metal ion, the organic compound, and the pillar ligand, that is, metal ion : organic compound : pillar ligand, is one of 2:2:1 and 1:2:1.

3. The organometallic complex structure according to one of claims 1 and 2, wherein the organometallic complex structure is expressed by one of formulae: $\{[M_2Y_2L]_2 \cdot xH_2O\}_n$ and $\{[MY_2L]_2 \cdot xH_2O\}_n$, where M represents the metal ion, Y represents the organic compound, L represents the pillar ligand, and x and n represent an integer.

4. The organometallic complex structure according to any one of claims 1 to 3, wherein the porous structure is a structure such that pores with a specific size are arrayed regularly.

5. The organometallic complex structure according to any one of claims 1 to 4, wherein the porous structure is a structure such that two organometallic layers adjacent to each other of two or more organometallic layers formed by the metal ion and the organic compound are linked by the pillar ligands, wherein the pillar ligands are arranged with the length direction thereof being a substantially same direction and spaced substantially at specific intervals.

6. The organometallic complex structure according to claim 5, wherein in the porous structure, a plurality of pores have a substantially specific size seen from the direction substantially parallel to the arrayed direction of the pillar ligands, wherein the pore is formed by two pillar ligands adjacent to each other, two another pillar ligands adjacent to the two pillar ligands and positioned substantially in parallel thereto, and a region of the organometallic layer, the region being surround by these four pillar ligands.

7. The organometallic complex structure according to any one of claims 1 to 6, wherein in the porous structure, the size of the pores is capable of being changed by a stimulus.

8. The organometallic complex structure according to any one of claims 4 to 7, wherein the organometallic layer comprises a structure in which organometallic layer structural units formed by the metal ion and the organic compound are bridged, wherein in the organometallic

layer, each of metal ions in two organometallic layer structural units is bridged by an organic compound of one organometallic layer structural unit and an organic compound of the other organometallic layer structural unit, the one and the other organometallic layer structural units each being different from the two organometallic layer structural units, to thereby form a metal ion dimer unit.

9. The organometallic complex structure according to any one of claims 5 to 8, wherein the orientation of a pillar ligand along the length direction, the pillar ligand being bound to one metal ion in the metal ion dimer unit of the organometallic layer and the orientation of a pillar ligand along the length direction, the pillar ligand being bound to the other metal ion are different from each other.

10. The organometallic complex structure according to any one of claims 1 to 9, wherein the metal ion is selected from Group 6 element to Group 12 element in the long form of a periodic table.

11. The organometallic complex structure according to any one of claims 1 to 10, wherein the metal ion is a divalent atom.

12. The organometallic complex structure according to any one of claims 1 to 11, wherein the metal ion is selected from a copper ion, a rhodium ion, a chromium ion, a molybdenum ion, a palladium ion and a zinc ion.

13. The organometallic complex structure according to any one of claims 1 to 12, wherein the organic compound is a bridging ligand capable of bridging to the metal ion.

14. The organometallic complex structure according to any one of claims 1 to 13, wherein the organic compound is selected from a heteroaromatic compound and a derivative thereof.

15. The organometallic complex structure according to any one of claims 1 to 14, wherein the organic compound is pyrazine-2,3-dicarboxylate.

16. The organometallic complex structure according to any one of claims 1 to 15, wherein the affinities of the organic compound and the pillar ligand are selected from hydrophilic and hydrophobic.

17. The organometallic complex structure according to any one of claims 1 to 16, wherein the affinity of the organic compound and the pillar ligand is one of hydrophilic and hydrophobic to each other.

18. The organometallic complex structure according to any one of claims 1 to 17, wherein the pillar ligand comprises a heteroaromatic compound.

19. The organometallic complex structure according to any one of claims 1 to 18, wherein the pillar ligand comprises heteroatoms at both ends thereof.

20. The organometallic complex structure according to any one of claims 1 to 19, wherein the pillar ligand is selected from pyrazine, bipyridine, azopyridine, dipyridylethylene, dipyridylbenzene, dipyridylglycol, dipyridylethane and dipyridylpropane.

21. The organometallic complex structure according to any one of claims 1 to 20, wherein the pillar ligand is at least one of capable of being expanded and contracted, and capable of being transformed.

22. The organometallic complex structure according to any one of claims 1 to 21, wherein the pillar ligand is at least one of capable of being expanded and contracted by a stimulus, and capable of being transformed by a stimulus.

23. The organometallic complex structure according to any one of claims 1 to 22, wherein the pillar ligand comprises two or more organic molecules, wherein at least two organic molecules of the two or more organic molecules interact with each other through π-π stacking.

24. The organometallic complex structure according to any one of

claims 1 to 23, wherein the organic polymer is selected from an ionic polymer.

25. The organometallic complex structure according to claim 24, wherein the ionic polymer is selected from a cationic polymer, an anionic polymer and an amphoteric polymer.

26. The organometallic complex structure according to one of claims 24 and 25, wherein the ionic polymer is polyvinylsulfonic acid, sodium salt.

27. The organometallic complex structure according to any one of claims 1 to 26, which is one of a plate-like crystal, a granular crystal, and a wire-like crystal.

28. The organometallic complex structure according to any one of claims 1 to 27, which is used for at least one of adsorption and desorption of a guest, and arrangement of a guest.

29. The organometallic complex structure according to any one of claims 1 to 28, which is used for at least one of selective adsorption and desorption of a guest, and selective arrangement of a guest.

30. A functional film comprising the organometallic complex structure of any one of claims 1 to 29.

31. A functional composite material comprising:

the organometallic complex structure of any one of claims 1 to 30; and

a guest,

wherein the guest is one of adsorbed and arranged in pores of the organometallic complex structure.

32. A functional structure comprising:

a substrate; and

the organometallic complex structure of any one of claims 1 to 29 on the substrate.

33. The functional structure according to claim 32, further comprising a guest,

wherein the guest is one of adsorbed and arranged in pores of the organometallic complex structure.

34. An adsorption and desorption sensor comprising:

the organometallic complex structure of any one of claims 1 to 29; and

a detecting unit configured to detect at least one of adsorption of a guest in and desorption of the guest from pores in the organometallic complex structure.

35. A method for producing an organometallic complex structure, comprising:

mixing a metal ion, an organic compound capable of binding to the metal ion, a pillar ligand capable of binding to the metal ion, and an organic polymer capable of interacting with the metal ion.

36. The method for producing an organometallic complex structure according to claim 35, wherein the mixing is carried out at temperatures of 50 °C or lower.

37. The method for producing an organometallic complex structure according to one of claims 35 and 36, wherein the amount of organic molecules to be mixed at the mixing satisfies: (mole of the organic molecules/ mole of the metal atom) ≥ 20.

38. The method for producing an organometallic complex structure according to any one of claims 35 to 37, wherein the mixing is carried out by stirring.

39. The method for producing an organometallic complex structure according to any one of claims 35 to 38, wherein after the mixing, an obtained crystal or a powder is subjected to a preferential orientation treatment, wherein in the preferential orientation treatment, pressure is applied to the obtained crystal or the powder from one direction.

40. The method for producing an organometallic complex structure according to any one of claims 35 to 38, wherein after the mixing, an obtained crystal or a powder is subjected to a preferential orientation treatment, wherein in the preferential orientation treatment, pressure is applied to the obtained crystal or the powder by pushing the obtained crystal or the powder with fingers from one direction.

41. The method for producing an organometallic complex structure according to any one of claims 35 to 40, wherein the metal ion is mixed as a compound containing the metal ion.